## REMARKS/ARGUMENTS

Claims 1-9 and 11-24 were previously pending in the application. Claim 24 is canceled, claims 1 and 21 are amended, and new claim 29 is added herein. Support for new claim 29 is found, for example, in Fig. 11 and in the corresponding text of the specification on pages 17-19. Assuming the entry of this amendment, claims 1-9, 11-23, and 29 are now pending in the application. The Applicant hereby requests further examination and reconsideration of the application in view of the foregoing amendments and these remarks.

### Claim Rejections

On page 2 of the final office action, the Examiner rejected claims 1-2, 4, 11, 13-16, 21, and 24 under 35 U.S.C. 102(b) as being anticipated by Nojima. On page 6, the Examiner rejected claims 1-3 under 35 U.S.C. 102(b) as being anticipated by Ciesielka. For the following reasons, the Applicant submits that all of the now-pending claims are allowable over the cited references.

#### Claims 1, 21, and 29

Claims 1 and 21 have been amended to clarify the claimed subject matter to emphasize distinctions between the present invention and the teachings in Nojima and Ciesielka and to overcome apparent confusion by the Examiner. Support for the amendments to claims 1 and 21 is found, for example, in Fig. 11 and in the corresponding text of the specification on pages 17-19.

Currently amended claim 1 is directed to a predistorter arrangement for linearising a distorting element. The predistorter arrangement comprises a pilot generator, a predistorter, and an error corrector. The pilot generator generates a composite signal comprising an input signal and a pilot signal. The predistorter predistorts the composite signal to produce a predistorted signal which is supplied to an input of the distorting element. The error corrector (1) receives a feedback signal corresponding to an output signal generated by the distorting element in response to the predistorted signal, (2) detects, in the feedback signal, cross-modulation distortion signals derived from cross-modulation of the input signal on the pilot signal within the distorting element, (3) produces an error correction signal based on the detected cross-modulation distortion signals, and (4) applies the error correction signal to the predistorter to adjust the predistortion of the composite signal by the predistorter to reduce the cross-modulation distortion signals in the output signal subsequently generated by the distorting element. As discussed in further detail below, the Applicant submits that the cited references do not teach or even suggest such a combination of features.

Fig. 11 shows an exemplary embodiment of the predistorter arrangement of claim 1, where:

- Elements 600 and 700 of Fig. 11 form an example of the pilot generator of claim 1;
- Element 200 of Fig. 11 is an example of the predistorter of claim 1;
- Element 100 of Fig. 11 is an example of the distorting element of claim 1; and
- Element 800 of Fig. 11 is an example of the error corrector of claim 1.

Regarding Nojima, the Examiner stated that, in Nojima, "There is inherent cross-modulation of the input signal on the pilot and there is intermodulation of the pilot signal." The Examiner then concluded that, in Nojima, "the error correction means with element 10 detects or is adapted to detect the

presence of distortion signals derived from cross-modulation of the input signal on the pilot signal and detects the presence of distortion signals derived from intermodulation of the pilot signal." The Applicant submits that the Examiner's latter conclusion does not necessarily follow from the Examiner's prior statement. In particular, just because cross-modulation of an input signal on a pilot signal may be "inherent" in Nojima, that does not necessarily mean that Nojima's system detects the presence of distortion signals derived from such cross-modulation. In fact, there is no teaching or even suggestion in Nojima that the disclosed system detects cross-modulation distortion signals. In fact, cross-modulation distortion signals are not even discussed in Nojima.

On page 17, lines 21-26, the Specification explicitly describes that, in an amplifier system having both an RF input signal and a pilot signal, possible distortion products include: (i) intermodulation distortion derived purely from the RF input signal, (ii) intermodulation distortion derived purely from the pilot signal, and (iii) distortion derived from cross-modulation of the pilot signal and the RF input signal.

Intermodulation and cross-modulation are well-known concepts in the relevant art. As explicitly defined in the Specification on page 1, lines 10-12, the non-linearity of an amplifier results in intermodulation distortion (IMD) corresponding to "output frequencies equal to the sums and differences of integer multiples of the input frequency components." For example, in an amplifier system having two pilot signals at frequencies $f_{p1}$ and $f_{p2}$, frequencies $2f_{p1}$-$f_{p2}$ and $2f_{p2}$-$f_{p1}$ are third-order intermodulation distortion signal components. See, e.g., Nojima, page 3, lines 28-29 ("In the figure, frequencies $f_{p1}$ and $f_{p2}$ are pilot signals and frequencies $2f_{p1}$-$f_{p2}$ and $2f_{p2}$-$f_{p1}$ are third-order intermodulation distortion signal components.")

Cross-modulation is different from intermodulation. Cross-modulation occurs when two signals are applied to a non-linear element, and the input modulation of one signal results in modulation of the other signal in the output of the non-linear element. See, e.g., Jack Roan, "Cross Modulation in a Full Duplex Transceiver: Causes, Effects, and Simulation," p.3, Agilent Technologies, July 2007 (http://eesof.tm.agilent.com/pdf/rfic_seminar_2007_roan.pdf) ("Cross modulation distortion (XMD) is the transfer of modulation from one signal to another due to nonlinearities in a mutual processing block (such as an amplifier)").

For example, if a modulated input signal and an unmodulated (e.g., CW) pilot signal are applied to a non-linear amplifier, cross-modulation of the input signal on the pilot signal refers to distortion of the pilot signal resulting from the transfer of modulation from the input signal to the pilot signal due to the non-linearities in the amplifier. As a result, instead of containing a pure amplified CW pilot signal, the output of the amplifier will contain a modulated pilot signal, where the modulation of that pilot signal results from cross-modulation of the input signal on the pilot signal.

Fig. 12 in the present application graphically represents both intermodulation distortion and cross-modulation distortion. In the example of Fig. 12, the inputs to a non-linear amplifier are the two RF input signals represented on the left side of Fig. 12 and an injected CW pilot signal on the right side of Fig. 12. As shown in Fig. 12, IMD includes sums and differences of the two RF input signals. In particular, Fig. 12 shows the third-, fifth-, and seventh-order IMD signals on either side of the two RF input signals.

Fig. 12 also shows the third-, fifth-, and seventh-order cross-modulation signals on either side of the CW pilot signal. The two RF input signals on the left side of Fig. 12 can be equivalently represented as a single modulated RF input signal. The cross-modulation signals shown in Fig. 12 result from the transfer of modulation from that single modulated RF input signal to the pilot signal due to non-linearities in the amplifier.

Thus, intermodulation distortion and cross-modulation distortion are very different from one another. While intermodulation distortion corresponds to frequencies equal to sums and differences of integer multiples of the input frequency components, cross-modulation of an input signal on a pilot signal corresponds to the transfer of modulation of the input signal onto the pilot signal.

Advantages of linearizing based on cross-modulation of the input signal on the pilot signal include (1) the ability to use a single pilot tone and (2) the ability to design the control system based on the known frequency of that single pilot tone.

In a typical amplifier system, the frequency components of the received RF input signal might not be known and/or they may change over time. Since IMD is a function of the sums and differences of integer multiples of input frequency components, the exact frequencies of the IMD products might also not be known and/or they may also change over time. To avoid this uncertainty, prior-art solutions, such as those described in Nojima rely on the insertion of <u>two</u> known pilot signals so that IMD products based solely on those two pilot signals will be known and the control system can be designed based on those known IMD product frequencies.

By controlling the linearization of an amplifier system based on cross-modulation of the input signal on the pilot signal, the present invention can be (but does not necessarily have to be) implemented using a <u>single</u> CW pilot tone. Since cross-modulation of the input signal on the pilot signal corresponds to modulation of the amplified pilot tone, the control system can be designed based on the known frequency of that single pilot tone. The modulation of the amplified pilot tone may vary for different RF input signals, but the frequency of the amplified pilot tone will not. As a result, the present invention can be implemented in an amplifier system having a single pilot tone, wherein the control system is designed based on the known frequency of that single pilot tone.

The cited references simply do not teach or even suggest such a combination of features.

For example, Nojima teaches an amplifier system having <u>two</u> pilot signals where the amplifier system is linearized based on <u>IMD</u> products of those two pilot signals. While it may be true that there is "inherent cross-modulation of the input signal on the pilot" in Nojima's amplifier system, that does <u>not</u> mean that Nojima's system controls linearization <u>based on</u> detection of cross-modulation distortion. There is <u>no</u> discussion of cross-modulation at all in Nojima, let alone a discussion of the use of cross-modulation distortion to control the linearization of an amplifier.

Ciesielka teaches a technique for tuning a circuit having an amplifier. According to this technique, <u>instead of</u> applying an input signal from information source 10, pilot tone source 15 sequentially applies individual pilot signals having different frequencies to the circuit to adjust the frequency-dependent gain characteristic of equalizer 30. See, e.g., column 3, lines 29-57. Ciesielka's Fig. 1 clearly shows a two-pole switch having two switch positions: a first switch position in which <u>only</u> a pilot signal from pilot tone source 15 is applied to the circuit and a second switch position in which <u>only</u> a signal from information source 10 is applied to the circuit. There is <u>no</u> switch position taught in Ciesielka in which signals from <u>both</u> pilot tone source 15 and information source 10 are <u>simultaneously</u> applied to the circuit. In fact, doing so would destroy the functionality of Ciesielka's tuning technique.

Since signals from pilot tone source 15 and information source 10 are never simultaneously applied to Ciesielka's circuit, Ciesielka's circuit cannot possibly be interpreted as being controlled based on cross-modulation distortion of an input signal on a pilot signal, because such cross-modulation distortion <u>never even exists</u> in Ciesielka. Ciesielka contains no discussion of cross-modulation distortion

or even intermodulation distortion. This makes sense since <u>only one signal at a time</u> is ever applied to Ciesielka's circuit and such distortion therefore does <u>not</u> even exist.

The Examiner's argument also includes statements like: "Just because something inherently detects these things does not mean that any thing is done with these things. All that is required by many of the claims is that these things are detected, not that anything occurs after the detection of these things." See page 4, lines 20-23. Claim 1 has been amended to clarify that real things occur after other things are detected. In particular, according to currently amended claim 1, after the cross-modulation distortion signals are detected, an error correction signal is produced <u>based on</u> the detected cross-modulation distortion signals and the error correction signal is applied to the predistorter to adjust the predistortion of the composite signal by the predistorter to reduce the cross-modulation distortion signals in the output signal subsequently generated by the distorting element. As such, the Applicant submits that the Examiner's argument that nothing is done after detection is no longer relevant.

For all these reasons, the Applicant submits that currently amended claim 1 is allowable over the cited references. For similar reasons, the Applicant submits that currently amended claim 21 and new claim 29 are allowable over the cited references. Since independent claims 1 and 21 are allowable, the Applicant submits that all of the withdrawn claims must now be brought back into consideration. Furthermore, since the rest of the pending claims depend directly or indirectly from claims 1 and 21, it is further submitted that those claims are also allowable over the cited references.

<u>Claim 3</u>

According to claim 3, the predistorter arrangement further comprises a pilot remover <u>located downstream of the amplifier</u> and adapted to remove the amplified pilot signal from the amplifier output signal prior to or following detection of the presence of distortion signals derived from the pilot signal in the amplifier output signal. Since the cited references do not teach or even suggest such a pilot remover, the Applicant submits that this provides additional reasons for the allowability of claim 3 over the cited references.

<u>Claim 7</u>

According to claim 7, the pilot signal is derived from the input signal. Since the cited references do not teach or even suggest such a feature, the Applicant submits that this provides additional reasons for the allowability of claim 7 (and also claim 8) over the cited references.

<u>Claim 8</u>

According to claim 8, the pilot signal is a frequency translated version of the input signal. Since the cited references do not teach or even suggest such a feature, the Applicant submits that this provides additional reasons for the allowability of claim 8 over the cited references.

<u>Claim 9</u>

According to claim 9, the pilot signal is a single tone signal. Since the cited references do not teach or even suggest such a feature, the Applicant submits that this provides additional reasons for the allowability of claim 9 over the cited references.

Claim 12

According to claim 12, the frequency of the pilot signal is frequency hopped. Since the cited references do not teach or even suggest such a feature, the Applicant submits that this provides additional reasons for the allowability of claim 12 over the cited references.

Claim 17

According to currently amended claim 17, the adjuster comprises an in-phase adjuster and a quadrature phase adjuster. Since the cited references do not teach or even suggest such features, the Applicant submits that this provides additional reasons for the allowability of claim 17 over the cited references.

Claims 18 and 22

According to currently amended claim 18, the predistorter arrangement comprises first and second predistorters, first and second pilot generators, and first and second error correctors, where the first predistorted input signal generated by the first predistorter is processed by the second predistorter to produce the predistorted input signal supplied to the distorting element. Fig. 22 shows an example of the predistorter arrangement of claim 18. Since the cited references do not teach or even suggest such features, the Applicant submits that this provides additional reasons for the allowability of claim 18 (and also claims 19-20) over the cited references. The Applicant submits that this similarly provides additional reasons for the allowability of claim 22 (and also claim 23) over the cited references.

Claim 19

According to currently amended claim 19, the first and second predistorters are adapted so that only one of them cancels higher order distortion. Since the cited references do not teach or even suggest such features, the Applicant submits that this provides additional reasons for the allowability of claim 19 over the cited references.

Claim 20

According to currently amended claim 20, the first and second error correctors share one or more components in common. Since the cited references do not teach or even suggest such features, the Applicant submits that this provides additional reasons for the allowability of claim 20 over the cited references.

Claim 23

According to claim 23, one of the predistorters is inhibited from error correction while the other carries out correction to produce a steady state, and is then enabled to carry out correction. Since the cited references do not teach or even suggest such features, the Applicant submits that this provides additional reasons for the allowability of claim 23 over the cited references.

Conclusion

For the reasons set forth above, the Applicant respectfully submits that the rejections of claims under Section 102(b) have been overcome.

In view of the above amendments and remarks, the Applicant believes that the now-pending claims are in condition for allowance. Therefore, the Applicant believes that the entire application is now in condition for allowance, and early and favorable action is respectfully solicited.

Respectfully submitted,

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